

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

REMARKS

Review and reconsideration on the merits are requested.

Applicant appreciates the Examiner indicating that the priority papers have been received and the drawings have been approved.

The prior art: U.S. Patent 2002/0110739 McEwen et al (McEwen); U.S. Patent 6,190,805 Takeuchi et al (Takeuchi); U.S. Patent 4,643,958 Thrash et al (Thrash).

Claims 1-7 were pending at the time of rejection.

The rejections: claims 1-7 were rejected under 35 U.S.C. § 102(e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over McEwen.

Claims 1-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takeuchi and further in view of Thrash.

The above rejections are respectfully traversed.

The gel polymer electrolytes (GPE)/polymer matrixes of McEwen are produced using radically polymerizable monomers, such as acrylate monomers, e.g., TEGDA and MMA, in the presence of small quantities of ABIN or DDO under UV light as disclosed in Paragraphs [0067] to [0072] of page 5 of McEwen.

Referring now to the present specification, at pages 1 and 2 it is disclosed that a secondary cell using a polymer-in-salt-type solid electrolyte composition, which is prepared by radical-polymerizing a monomer such as a (meth)acrylate monomer, is insufficient in cell characteristics. It is further disclosed that the preparation of such an electrolyte composition requires a polymerization initiator, a radical-generating device such as a light source, etc., which

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

by necessity results in rather complicated operation (see the present specification at page 1, line 24 to page 2, line 2).

In contrast to the GPE/polymer matrixes of McEwen, the electrolyte composition of the present invention is easily prepared by conducting a reaction between an electrophile having at least two polarized unsaturated bond and a nucleophile having a plurality of nucleophilic groups including -NH₂, -SH, -S⁻, -SO₂H, SO₂⁻, OH, COOH, etc., in a molten salt. A non-aqueous electrolyte secondary cell using such an electrolyte composition will exhibit excellent cell characteristics (see page 2, lines 11-16 and page 19, lines 8-13 of the present specification, emphasis added).

In more detail, the specification of the present application makes it quite clear that not only are cell characteristics such as relative capacitance and cycle capacitance superior but, further, leakage in Examples 1 to 11 using electrolyte composition films F-1 to F-11 of the present invention, prepared by the method of the present specification, are unexpectedly superior to those of Comparative Examples 1-6 given in Tables 2 and 3, which are based on the use of an electrolyte composition film, F-16, as shown in Table 1. Electrolyte composition film F-16 was prepared by radical-polymerizing radically polymerizable monomers, hydroxyethylmethacrylate (HEMA) and ethylene glycol dimethacrylate (EGDMA) in an inorganic salt with the free-radical initiator in almost the same manner as disclosed in Paragraph [0070] of McEwen.

It is believed by Applicant that this unexpected superiority in cell characteristics and leakage derives from the structural difference between the electrolyte composition of the present invention, which has a cross-linked structure which indispensably includes or inherently includes

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

at least one hetero-atom such as M, S, etc., which is prepared by a Michael-type addition reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups in the presence of a basic metal salt (see the present specification at page 14, lines 4-10 and page 21, line 4 to page 25, line 4 of the present specification) as compared to a structure which includes no hetero-atom in the electrolyte composition prepared by radical polymerization according to McEwen.

McEwen does not teach or suggest an electrolyte composition prepared by conducting a reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups in a molten salt in the absence of a radically polymerizable monomer. Accordingly, Applicant respectfully submits that claim 1 of the present application is not anticipated by nor rendered obvious by McEwen.

Applicant submits that claims 2-7 are patentable for the same reasons as advanced with respect to claim 1.

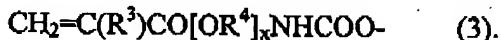
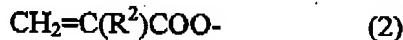
Applicant now addresses the rejection of claims 1-7 as obvious over Takeuchi and further in view of Thrash.

The electrolyte composition of the present invention having a cross-linked structure is, as discussed above, prepared by conducting a Michael-type addition reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups including -NH₂, -SH, -S⁻, -SO₂H, -SO₂⁻, -OH, -COOH, etc., in a molten salt (see claim 1; page 14, lines 4-10 and page 19, lines 8-13 of the present specification).

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

In contrast to the present invention, Takeuchi discloses a highly ion conductive solid polymer electrolyte comprising a polymer compound having a cross-linked and/or side chain group mainly comprising a poly- or oligo-carbonate group and an electrolyte salt (see column 5, lines 39-42, emphasis added).

The Takeuchi polymer compound containing a poly- or oligo-carbonate group is preferably obtained by a polymerization reaction using a polymerization functional group represented by formula (2) and/or formula (3) below (see Takeuchi at: Abstract; column 15, line 50 to column 16, line 8; column 18, line 66 to column 19, line 9; and column 20, lines 42-57 in view of column 22, lines 19-60):



Accordingly, the structure of the polymer compound in the highly ion conductive solid polymer electrolyte of Takeuchi, which has no hetero-atom N, such as S, etc., bonded to a C atom of a C=C double bond is completely different from that of the electrolyte composition, of the present invention having a cross-linked structure which indispensably or inherently includes at least one hetero-atom such as N, S, etc. (see also column 18, line 66 to column 19, line 9 of Takeuchi).

As can be seen, Takeuchi is silent regarding an electrolyte composition having a cross-linked structure which indispensably or inherently includes at least one hetero-atom prepared by a Michael-type addition reaction between an electrophile having at least two polarized unsaturated bonds and a nucleophile having a plurality of nucleophilic groups in a molten salt.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

Accordingly, Applicant respectfully submits that one of ordinary skill in the art referring to Takeuchi would not be motivated to reach the invention as recited in claim 1 and claim 1 is not obvious over Takeuchi.

However, the rejection is further in view of Thrash, and Applicant now addresses Thrash.

Turning to Thrash, Thrash discloses lithium-sulfur dioxide electrochemical cells which utilize a minor amount of a quinone imine as an electrolyte additive to improve the characteristics of such cells (see column 2, lines 56-66 and column 3, lines 60-66 of Thrash). In Thrash, various combination of electrolyte salts comprising at least one material ammonium salts, phosphonium salts, pyridinium salts, and arsonium salts with one or more lithium salts are preferred. Thrash also teaches a liquid sulfur dioxide solution which has 0.02 molar in $Mn(2,2'-dipyridyl)_3(ClO_4)_2$ and saturated in lithium perchlorate ($LiClO_4$) as an electrolyte (see column 6, lines 47-57 and column 8, column 46-49 (Example 1)).

Despite the above disclosure, Thrash is completely silent regarding the use of a polymer matrix for infiltrating a liquid electrolyte composition.

It is accordingly respectfully submitted that Thrash provides no motivation for one of ordinary skill in the art to reach the invention recited in claim 1 herein, and claim 1 is not obvious over Thrash.

Applicant appreciate, of course, that the rejection is a combination rejection. Overviewing Takeuchi and Thrash, neither reference teaches or suggests an electrolyte composition having cross-linked structure which indispensably or inherently includes at least one hetero-atom, which electrolyte composition has been prepared by reaction between an

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No.: 10/024,187

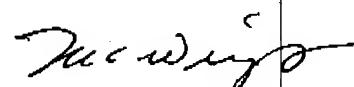
electrophile having at least two polarized unsaturated bonds and an nucleophile having a plurality of nucleophilic groups in a molten salt, important features of the present invention.

Accordingly, Applicant respectfully submits that claim 1 is not rendered obvious by the combination of Takeuchi in view of Thrash and, for the reasons advanced regarding claim 1, claims 2-7 are also patentable over the combination of Takeuchi and Thrash.

Withdrawal of all rejections is requested.

The Examiner is respectfully requested to consider this process claim since it so nicely correlates with the arguments Applicant has advanced.

Respectfully submitted,



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